HINTS

—TO—

PLUMBERS

AND

HOUSEHOLDERS.

BY W. L. D. O'GRADY.

With Illustrations.

NEW YORK:
PUBLISHED BY THE AMERICAN NEWS COMPANY.
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CONTENTS.

INTRODUCTION.

THE plumber holds in his hands the keys of life and death. If he is intelligent, skillful, conscientious, he can stand guard and defeat the most insidious enemy that mortal man has ever had to fight in the great city. If he lacks in these qualifications, he opens the doors of death.

The plumber's task is not a pleasant one. He is often compelled to do duty of the most disagreeable kind, to inhale vile odors, and gases that are inimical to health and life itself. But he shrinks from no task, however great the risk he may incur.

The householder is interested in this man. He is the householder's friend, and his work should be appreciated. There should be a mutual understanding between the two. Both

should seek information concerning the best methods for fighting the foe which night and day seeks to gain access to our dwellings. On the one hand there should be conscientious workmanship; on the other a generous appreciation that manifests itself in paying fair prices for services rendered. Cheap plumbing implies bad work, and bad health.

This little book is sent out with the hope that, inasmuch as it is published in a cheap form, it will meet the popular want. It is intended, as its title indicates, for the plumber and for the householder.

CHAPTER I.

TRAPS.

Where great numbers of people are gathered together, emanations of a dangerous character to health, which are generated in even the smallest communities, become so intensified that to remove their evil effect science has to be called into play. We hear every now and then of some isolated country farm-house being a perfect death-trap, but on investigation it is always found that the deadly results ensue from long continued and gross neglect.

Moses, the earliest lawgiver, whose wise precepts have been the basis of all existing sanitary regulations in civilized countries, entered into very minute legislation in sanitary matters. Moses, however, knew no such cities as those of to-day, and probably knew nothing about lead, which is so important a feature in plumbing and from which (*plumbum*—Latin for lead) the words plumbing and plumbers are derived.

The tribes of Israel, when Moses ruled them, were dwellers in tents, and when they arrived at Judea, for years and years, and cen-

turies, their houses were, as a rule, one story structures, and all sanitary conveniences were in the primitive style, which indeed lasted into our day, and still lasts even in this civilized land, in many places, in the shape of cesspools.

Now, cesspools are poisonous, and, although, if at a distance from dwellings, their effluvia may not be disagreeable except in their immediate vicinity, they poison the air, and in certain states of the atmosphere, in cloudy, damp days, for instance, with a wind blowing directly on a house, produce very serious effects.

Modern civilization in cities has provided, as did the civilization of old Rome, for carrying away the dangerous elements in sewers. But the deleterious gases do not depart so readily. They lurk about. They fly to the easiest vent, and whenever they have access to inhabited apartments destroy health, if they do not kill. But for the plumbers many thousands of lives would annually be lost more than are now. The deadly cholera of India, which has worked its way westward season after season, sometimes more than at others, but a regular annual visitant to Europe, beginning among the crowded pilgrims to the sacred shrines of Hindostan,

Plate No. I

Fig. 1

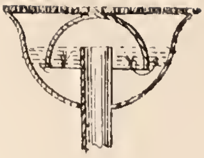


Fig. 2

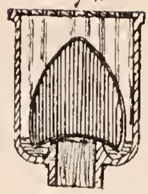


Fig. 3

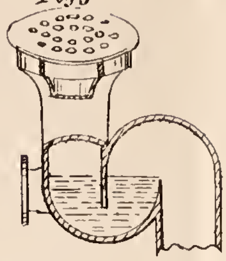


Fig. 4

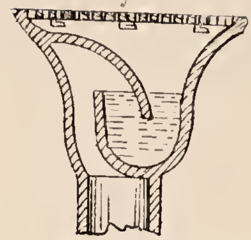


Fig. 5

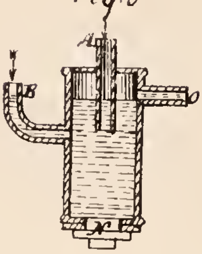


Fig. 6

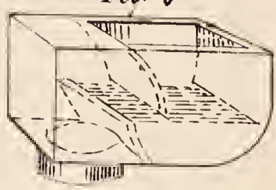


Fig. 7

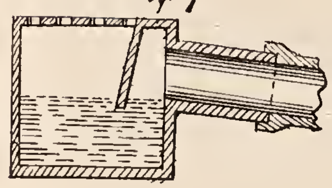


Fig. 8

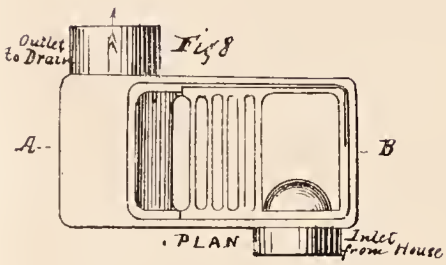


Fig. 9

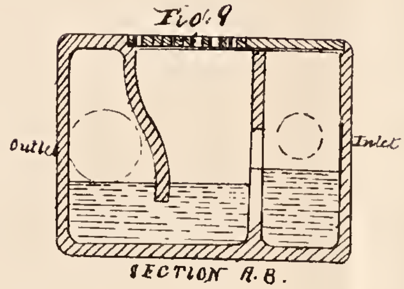


Fig. 10

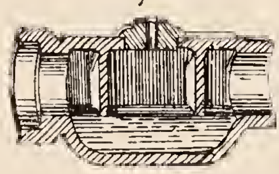


Fig. 11

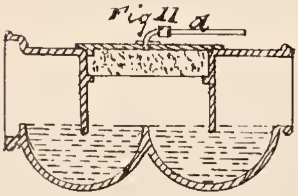


Fig. 12

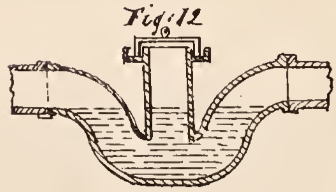


Fig. 13

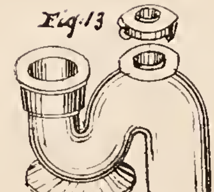
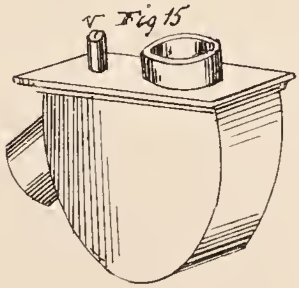


Fig. 14.

Fig. 15



conveyed by pious Mohammedans flocking to Mecca, brought by sea and land from the ports of the Levant, and which has occasionally cruelly scourged America ; typhus and typhoid fever, and diphtheria, are nothing but sewer gas diseases.

How shall these sewer gas diseases be prevented? The first sensible idea, exorcism and other superstitious efforts having been previously ineffectually tried, was to keep the gas away. The existence and nature of the gas had first to be recognized, and then it became possible for intelligent means to be taken to keep it away. Fire and water are the two great purifiers, but it was not easily seen how fire could help in this matter, so people naturally began to call on water to help them, and, after a great deal of thought and experimenting, arrived at the idea of traps with a water seal.

Typical specimens of several well-known traps are shown in Plate No. 1, and other traps, each claiming peculiar advantages, are quite numerous.

Traps of a proper construction are indeed most important, but where to place them is a matter of still greater importance. The best traps may be placed where they may become most mischievous, and, in fact, do a great deal more harm than good.

CHAPTER II.

TRAPS—CONTINUED.

There should be a small trap close to every water-closet and every wash-basin and every sink provided among "modern improvements," but *the main soil-pipe should be kept clear.*

There are serious differences of opinion on this point. Many prominent plumbers state that they, for their part, will not ventilate the sewers through their houses, or those of their clients. They hold that the ventilation of sewers and their individual soil-pipes in houses cause such a vitiation of the surrounding atmosphere as to be highly dangerous, and that they can stop the sewer gas from entering houses by water-seal (or, in some cases by mechanical devices, such as floating gutta percha or india rubber balls) so that the gas must be driven to the outlet of the sewer, as the easiest way to escape.

But the outlet of sewers is frequently subject to the influence of tides, and where the mouth of the sewer is obstructed by tides, the gas will find its vent elsewhere,

and it will always seek its easiest outlet, and the easiest outlet is, usually, nearest the source of its production.

The law in New York, and very generally elsewhere, is that soil-pipes should be left clear to and above the roofs of houses. The law does not dogmatize as to the number of traps in this soil-pipe.

If the principle of pure ventilation is correct, there should be no trap in the upright pipe at all.

There should certainly be traps in the lateral pipes connecting with the drains.

These are the views of many most eminent men, and have recently been forcibly enunciated by a prominent manufacturer of traps, who states plainly, and perfectly disinterestedly, that the adoption of his views will, in all probability, lessen the demand for the goods he makes.

This is not the place to discuss the merits of any particular trap, but, if this theory of a clear, ventilated, upright soil-pipe is correct, and that is the law, so far, at least, as it is laid down that the pipe should be carried clear of the roof, it would appear to matter comparatively little what trap is used for the horizontal pipe.

The witty clergyman, the Rev. Sidney Smith, once observed that railway accidents would never cease till a bishop had been sacrified. Bishops and other important persons have succumbed to railway accidents, and, in point of fact, such accidents have since been fewer and less severe.

It may, perhaps, be said that death by sewer gas will not be considered a crime till distinguished people have, knowingly, been subject to it. They have died by it; and the Royal family of Great Britain has been peculiarly pursued by it. Fifth avenue mansions cannot keep out the seeds of disease borne on the winds from tenements sacrificed to sewer gas by ignorance, carelessness or greed; and the young and beautiful, and the pretty little babies of the most prosperous as well as of the humblest families, have, for years, succumbed to the poisonous breath first breathed in noisome tenement houses, though not seldom introduced through some unsuspected leak direct into the house they live in.

A few dollars rightly spent, with vigilance, might make even the poorest tenement house in New York City as pure as the air of heaven above it.

It has been objected that if every householder in a city had his soil-pipe clear to the

sky that the aggregate of the offensive gas would poison the community. Does it not poison the community as it is? There would be comparatively little harm in the gas when mixed with atmospheric air at a level many feet above the sidewalk.

Clear the ground atmosphere, and citizens will be healthy. And as to soil-pipes, keep them clear, *without any traps* at all, in the perpendicular, and if necessary, supplement the buoyant properties of the gas by special ventilating apparatus. Give the gas a clear and sufficient passage, and pure air will rush in to supply its place below.

This is common sense. But the lateral traps must not be forgotten.

Fig. 1 is an illustration of the section of the ordinary bell trap. These traps consist of a ball attached to the grating and dipping into the water, retained in the chamber of the trap, and covering the discharge pipe. The seal of these traps rarely exceeds one quarter of an inch in depth, and they cannot be depended upon, as servants will remove the grating and the trap with them, and so place the house in direct communication with the sewer. Moreover, the small amount of seal provided in traps of this class is soon

lost by evaporation, especially in the heated rooms in which they are often placed.

Fig. 2 is an illustration of the self-acting valve trap of Mr. Clark, of Reading, England. It consists of a lead receiver 4½ in. diameter, with a brass grate on the top. The receiver holds about half an inch of water, into which the outer edge of the hollow-turned copper ball dips when its indented bottom rests on the top of the outlet-pipe, forming a valve trap. When water enters through the brass grating, the ball floats and allows it to escape, but so soon as the flow subsides, the ball resumes its position. This is a decided improvement on the ordinary bell trap, but is liable to be tampered with, and both the grating and valve may be readily removed, leaving the drain untrapped.

Fig. 3 is an illustration of Tye and Andrews' sink trap. Its advantage consists in the greater depth of seal provided. The gratings are usually locked, which is no advantage, as servants should be instructed not to cast matters down the gullies which they are not intended to receive, and also to periodically clean out the trap in order to free it from those matters liable to unseal it. Ample space, therefore, should be provided

in all traps, so that the hand may be freely inserted for the removal of any matter prejudicial to the action of the trap.

Fig. 4 is a representation of Antill's trap with Stidder's lock grating. This forms a very efficient trap.

Fig. 5 is a trap suitable for a lavatory, constructed in order to catch soap. The plug at the bottom may be removed, and the deposit of soap taken out. A is the pipe leading from the bottom of the basin; B is the overflowing pipe from the basin, and O the discharge pipe.

Fig. 6 is an illustration of a house trap supplied with a down outlet.

Fig. 7 is an ordinary house trap.

Figs. 8 and 9 are illustrations of the plan and section of Mansergh's trap. This trap is specially intended to prevent the ingress of sewer gas into houses by "waste and overflow pipes from cisterns, baths, lavatories, bath and lavatory safes, and sinks," and is always to be placed outside the house. In one piece of stoneware two water seals are formed, and between the two is an open communication to the air by means of the surface grating. If, therefore, the pressure in the branch drain is sufficient to force the gas through the first or lower seal, it will escape

into the air, and cannot possibly pass the second seal, and so enter the house. It has the advantage of receiving the waste water underground, out of sight; there is consequently never any foul water on the surface. The open grating admits of its serving as a yard gully.

Figs. 10 and 11 are illustrations of an "Intercepter" trap. In Fig. 10 the trap is provided with a ventilating-pipe, and in Fig. 11 charcoal is applied in mass, through which sewer air which may pass the trap is allowed to escape. This form of trap is intended to be fixed close to the outer wall of a building. The receptacle for the water-lute is in two compartments, *a a*, into which a diaphragm or plate *b* dips, and an intercepting chamber *c* is thus formed, by means of which the sewer gas forcing a passage is caught and carried off by a pipe *d* to any convenient place for its escape.

Fig. 12 is a representation of an ordinary flat siphon trap, provided with a junction for inspecting and cleaning the trap when required.

Fig. 13 is a representation of an S trap, fitted with an opening on the top of the trap, closed with an air-tight cap, made after the manner of the stopper of a pickle jar.

Fig. 14 is an ordinary P siphon trap. This form of trap is largely used, and is well adapted to form the trap of a water-closet, and is much more readily flushed and kept clean than some other forms of siphon trap.

Fig. 15 is the representation of a D trap, with ventilating pipe V. This form of trap is very generally adopted by plumbers, and is usually made in lead. It is also made in earthenware. It is a dip trap, which forms a siphon.

CHAPTER III.

HOW TO FIGHT SEWER GAS.

About the upright arrangements of a house, there are, as we have said, very different opinions. When, as in cities, connections with the sewers are made, and are carried up according to law, above the roof, the occupants of dwellings are apt to rebel at the idea of making themselves constructive scavengers for other people—or even for themselves.

Another idea has been mooted, and it has even been tried in some cities in Europe.

Heated chimneys—or great air shafts—of enormous dimensions, have been connected with the main sewers, and the gases, induced in their direction, poured in masses from them.

Whether so concentrated the gases from a city could be sufficiently rendered innoxious, is a serious question. It might fairly be argued that a mass of putrid gas so collected in one locality, and liable to be wafted in a solid column of pestilence, must be something terrible, and that the atmospheric air immediately adjacent to such an outflow of plague could not so amalgamate with it as to render it harmless.

This is possible. It has been suggested, for instance, that in the city of New York, sewer gas outlets connected with the main sewers should be made next the heated chimneys of the various factories. If the air were still and the factories equi-distant, there is no doubt that the foul air could be drawn out from the sewers and the pressure on private houses very much lessened, and, indeed, almost extinguished, so that, at any rate, the most ordinary traps would suffice to keep out sewer gas and keep the premises clear.

But, with any of the winds which so rarely desert New York, some one or other of these

outlets connected with the sewers would have to bear the brunt of the whole pestilential burden, and the effects of such an unseen column of concentrated sewer gas might well be imagined as something appalling.

In support of these views we annex a powerful and convincing article by one of the greatest of modern domestic architects, as contradistinguished from the gentlemen whose aim is to immortalize themselves with the inception or restoration of great churches and cathedrals. We speak of R. Norman Shaw, who has gained such celebrity in connection with the revival of the so-called Queen Anne style of architecture.

He speaks thus :

It is hardly necessary to enter on a lengthy essay to urge the desirability of having our houses efficiently drained, as nearly all people nowadays are fully alive to the necessity ; and the numerous inventions which are continually being brought out, prove that a very wide-spread feeling exists, that our present arrangements are far from satisfactory, and are capable of much improvement. One of the drawbacks of all these new inventions is that they complicate more or less the plan generally in use; either the mechanism is more elaborate, and consequently more li-

able to get out of order, or they require greater attention, as in the case of all those in which the improvement consists in the mechanical application of any deodorizing or disinfecting chemical ; with any arrangement of this latter kind, when the novelty is worn off, it ceases to be attended to regularly, and so becomes practically useless.

My object in writing these notes is to explain a plan I have adopted, and has been found to be perfectly efficient ; it is simpler and less costly than the plan generally in use ; and as it is absolutely impossible for sewer gas to enter a house where it is used, it follows that the occupants are free from all danger from this source—a point that cannot be too strongly dwelt upon, when it is remembered that several of our most serious outbreaks of epidemic fever have been directly traced to a defective state of house drainage, and also that medical men tell us that much illness, and even mortality, exists among children and people of delicate constitution, arising from the same cause ; in fact no one is safe : it is a danger ever present, and is seldom discovered or even suspected till too late.

The modern plan, with hardly an exception, is to connect our closets with the under-

ground drains by closed soil-pipes, trapped at one or more points. The plan I have adopted is to connect the closets with the drains by open soil-pipes, and to leave out all traps with the exception of one. Thus no lead D traps are required; no so-called ventilating pipes; no expensive junctions to make (always a source of weakness and danger): the whole arrangement becomes simplified at once; and as a natural result is not so liable to get out of order. In the ordinary plan a quantity of foul sewer gas is constantly being generated in the long length of closed soil-pipe. In my plan, as the soil-pipe is open, no gas can be generated or remain in it.

The simplest plan is to make a short arm of lead pipe attached direct to the lower portion of the valve-box just where the D trap generally comes, and led through the exterior wall of house in an easy bend, discharging into a funnel-shaped head of lead, forming the top of the soil-pipe. The soil-pipe is 3in. in diameter, but might with advantage be less, open at the top and bottom, the lower end terminating about 3in. or 4in. below the level of the ground, and directly over a carefully constructed siphon trap of glazed earthenware, but leaving an open

space of 6in. or 8in. between the foot of the soil-pipe and the top of the siphon.

The action is extremely simple—when the handle of the closet is pulled up, the contents of the pan rush, *unimpeded by any trap*, straight through the short arm first mentioned, fall directly down the vertical *open* soil-pipe, and sweep through the trap with considerable force into the underground drain; there is no place for any matter to lodge. In the ordinary arrangement, the contents of the pan fall into the D trap fron a height of only a few inches; this trap has a constant tendency to choke; and it is no exaggeration to say that it is never clean. To ventilate this trap and soil-pipe, it has become a custom to put in what are called "ventilating pipes," carried to the ridge of the house or the top of a chimney. They certainly serve to take off the extreme pressure of gas contantly accumulating in the upper part of the soil-pipe, and some of which is generally liberated whenever the handle is pulled up; but that is all they do—in no way can they be said to ventilate the soil-pipe; any more than a room could be said to be ventilated if it had a 2in. pipe inserted in the ceiling; they are better than nothing, and that is all that

can be said for them ; but in this arrangement no ventilating pipes are required, as the air gets freely to every part.

When first I adopted this arrangement, I expected occasionally to find impure matters at the foot of the soil-pipe, and had not fully realized the very cleansing effect of the fall of water. I also thought it probable that this part might become coated over with a foul deposit, which might occasionally require to be removed, but after an experience of two years, I have never once seen anything objectionable, nor is there the slightest deposit on the upper part of trap. This trap has never been cleaned out or touched in any way, nor have any disinfectants ever been poured down any of the closets. Then I was warned by sanitary experts and plumbers alike, that there would be sure to be a smell ; first, at the grating at level of ground ; secondly, at the top of the open soil-pipe ; and thirdly (owing to the absence of a trap), in the closets. No one has ever yet been able to detect the slightest smell at the grating, nor at the top of the soil-pipe, and the closets are exceptionally sweet. They are fitted with "water waste preventors," so that when the handle is held up till the water has ceased to flow, the air can

generally be felt to blow up the pipe, but it never brings with it any smell of an offensive nature.

Plate No. 2 shows the general arrangement clearly enough for all practical purposes. It will be noticed that there are two closets discharging into one soil-pipe ; one of these closets has a short arm about 4 ft. long, the arrangement that would be most usually required, but in order further to test the system, I made the other closet with a long arm, upward of 12 ft. from the pan to the open mouth of pipe. This latter is just as satisfactory as that with the shorter arm, being absolutely free from smell. I may add that I shall be glad to have the opinions of all interested in this subject, whether friendly or hostile. I have no patent to protect, nor any interest of any kind at stake. My only desire is to secure the simplest and most efficient means of affecting that which is admitted to be a difficulty and a source of danger.

R. Norman Shaw.

The following is an epitome given in *The Plumber* of the objects to be sought in every dwelling to secure a good sanitary condition :

1. No cesspool, for the collection or detention of putrefying liquid refuse, should exist

Plate No. 11

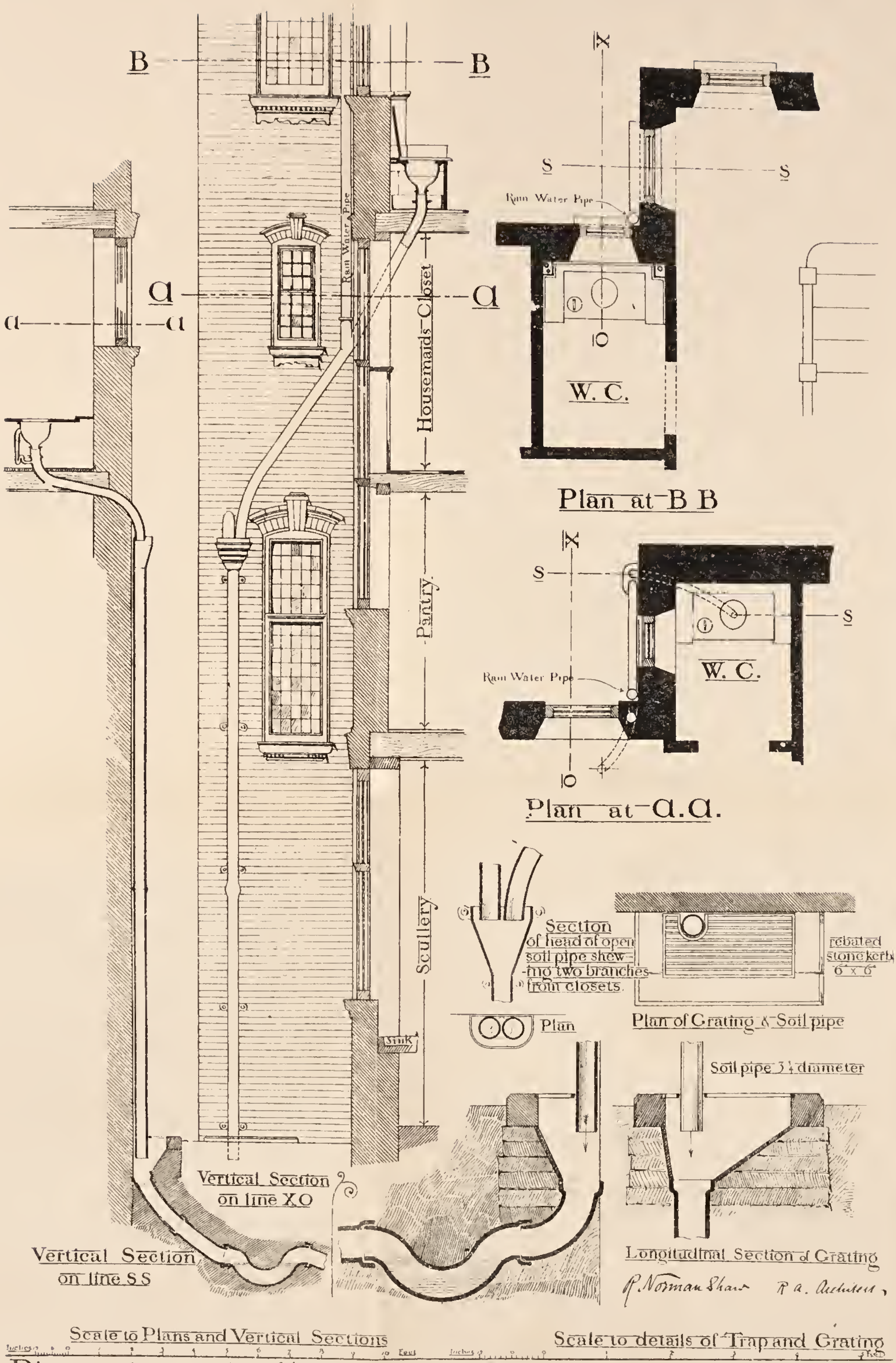


Diagram shewing plan of house drainage by open instead of closed soil pipes.

within or under any dwelling under any pretext whatever.

2. No sewer should pass under any dwelling, if it can be possibly avoided.

3. All soil pipes of water-closets should be thoroughly ventilated, as should also any pipe or space connecting the closet with the soil pipe, so that there may be no collection of sewage air under the pan or valve of the closet itself.

4. All pipes from sinks and internal receptacles of slops should be disconnected from the sewer, and should discharge through the outer walls of the dwelling on to a trapped gully with grated covering.

5. All solid refuse collected in or near the dwelling should be removed at short intervals of time.

6. The private sewer connecting the dwell ing with the common (public) sewer, or with any "cesspool or other like receptacle," as well as all traps and gullies, should be thoroughly water-tight to protect the ground from pollution.

7. All private sewers should be kept clear of deposit by flushing, and kitchen grease

should be intercepted before it can enter the sewers.

8. The ground under and surrounding the dwelling should be drained, so that there shall be no subsoil water within three feet of the foundations.

9. All rooms and cellars in basements should be protected from the evils of uprising dampness by a layer of concrete under the floors, by damp courses in the walls, and by areas between the walls and the outer ground.

10. No water that will not answer to the "attainable standard of purity" should be used for domestic purposes, and where possible water should be supplied direct from its source, or from a public main, without the use of any cistern at all.

11. No water should be stored in a cistern within the dwelling, unless it is satisfactorily filtered after it leaves the cistern.

12. No water used for either drinking or cooking should be obtained from the same cistern as that from which water is directly drawn for water-closets and sinks.

CHAPTER IV.

PRACTICE AND PRECAUTION.

When called upon to put a house in order, it is not necessary to rip it to pieces from roof to cellar. There is a way to find out leaks in pipes which is simpler and more satisfactory.

To find leaks in soil and waste pipes, go to the roof of the house, and pour down the ventilating pipe a small quantity of ether, or, still better, because the odor is so familiar to everybody, a little essence of peppermint. Then temporarily close the ventilating shaft with an old board, or anything else that comes handy, in order to keep the smell from escaping. Then follow the pipe down to the cellar, if need be, and you may, with advantage, take some one along with you, who does not know what you have been about, so as to be sure you may not be deceived by imaginative odors affecting your own nose—a child would do as well as any one else—and, if there is a leak, the peppermint will soon make its presence known. You and your companion may smell it in the bath room, or in the cellar, but wherever

you do smell it, depend upon it, the leak is there. Then look for it, and stop it, and stop it well. So shall the grateful householder pay you promptly and joyfully, and recommend you to others as a model plumber.

There are great differences of opinion in matters concerning plumbing. For instance, it is held by many that the house sewer should be run underground, out of sight. Now, pure common sense should teach us that the horizontal pipe should be run in full sight along the side of the wall of the cellar, so that any defect can be promptly detected and remedied.

One good trap, and, practically, some of the old traps are as good as the new ones, and do not choke up as much as some of the new ones, outside of the house, is all that is requisite. There should be no trap at all in the ventilating upright shaft, and every part of the plumbing about a house should be easily accessible.

On no consideration should the ventilating shaft be used as a rainwater leader. This fatal mistake, by which foul air is pumped into houses is too often made, and, strange to say, too often strongly recommended by those who ought to know better.

The horizontal pipe should be of iron. Vitrified earthenware is cleanly but fragile, the hubs being especially liable to be destroyed by heat, and the cement to connect them is apt to crack where the crack may not be readily seen. Brick and mortar or cement drains are bad and should never be used.

No skill or care will suffice to keep them impervious to the gases which disintegrate them by chemical processes and allow liquid sewage to saturate them, and finally filter through.

One thing should be remembered : sewage will not run up hill any more than will water. The soil pipes should have a regular descent to the sewers, and no number of traps or devices of any kind will keep the pipes clear if they are horizontal or crooked or tipped the wrong way in any part of their course.

Lead waterpipes should always be used. They are, beyond doubt, the very best ; least likely to be defective, most easily repaired when defective, and in every respect superior to any other. They corrode easily, it is true, but watchfulness will prevent evil resulting from that unconquerable defect.

In coupling-pipes, the favorite way is to use iron sleeves, but this is not the best

way. Crevices are apt to occur, out of sight, which are suffered to work much evil, perhaps, before being suspected. The best way, though more expensive at first, is to caulk a brass thimble into the iron heel and solder lead pipe to the thimble.

To use putty or any common mortar or cement, is an outrage that no self-respecting plumber should be guilty of. He might just as well stuff up a hole with so much sponge, or lay aside all attempt at tight caulking, and just tie the pipes together with packthread.

Lead pipes, though the best that can be used, has one objection, which, unfortunately, Nature has as yet vouchsafed to human knowledge no provision against. Fortunately, though, for the plumbers, this objection necessitates their constant employment. When people are sufficiently posted, they will have the plumber in their houses as frequently and habitually as they call on the doctors when they or their families are sick, or on their lawyers when going to law.

It is one of the properties of lead that, under the influence of heat, it will expand. But it will not contract in anything like the same proportion, and, as hot or warm water are constantly being poured through lead

pipes, it stands to reason that in course of time, this expansion, without corresponding contraction, must cause leakage of gas. If people knew this, or the plumbers were to warn them of it, there would be frequent inspections, and the defects could be readily patched in a regular and systematic manner.

But the public has much to learn, and the plumber ought to make it his business to teach them. A sad case in point occurred to the brother-in-law of one of the most successful New York plumbers. That gentleman, with professional skill, detected, in his brother-in-law's house, which, by the way, had just been put into "thorough repair"—according to the landlord—the unmistakable presence of sewer gas. He was pooh-poohed for his pains, and facetiously told that he was looking for a job. Ten days after, the doubter was childless. His three children were swept off by diphtheria.

CHAPTER V.

THE PLUMBER'S WORST ENEMY.

The plumber has to contend with no more formidable enemy than the downright meanness of the people who employ him. Men who are liberal in others ways, are too ignorant to acknowledge the usefulness of the plumber, and grudge the money needed to keep their surroundings commonly healthful. Cheap work is at a premium, and in plumbing, as in everything else, cheapness and nastiness go together. Plumbing at a very low cost is not cheap, and might almost as well be omitted altogether.

And if men are stingy where their own houses are concerned, it is very certain that weak human nature will not induce them to be more thoughtful for the welfare of others, or more freehanded where themselves or their families are not immediately concerned, and, as a class, with of course many noble exceptions, landlords are very difficult people to stir up to a realizing sense of their duties in the way of plumbing. And some of them are downright rascals and only use plumbing at all because the law compels

them. They could not let their houses without an outward show of having them in thorough order, and the average tenant is incompetent to know anything about this, and is usually satisfied with the mere outward show.

In New York, a very wealthy and really well-meaning, though miserly, old landlord, got an estimate from a conscientious plumber for a magnificent brown-stone house. The plumber was told to figure low, and did figure low, bringing out his total for strictly necessary work, done cheaper than usual, to $850. The old man was horrified, and straightway betook himself to another so-called plumber, who didn't take any time in figuring, but learning the amount of the first estimate, offered to do it for $600. He got the job. Several people died in that house within the year, and the first man was called on to make the repairs that had become absolutely indispensable. His first discovery was that the soil pipe, carefully concealed underground (where, it will be remembered, we have said it should never be), was made of No. 22 sheet-iron stovepipe and had rusted through from end to end. The house was thus literally standing on an open cesspool. The bill for repairs was $300, and the damage

to the building amounted to at least as much more, so that cheap plumbing in this case did not an wer. And it never does answer.

Of course the competition of trade tends to make plumbers, like other men, anxious to get jobs, and to bid low for them, but no man has a right to expose his fellow-men to death by bidding lower than he can do honest work for, and then doing dishonest work in order to reimburse himself. There are conscienceless scamps who will do this, plenty of them, and the public, in its ignorance and misguided parsimony, encourages them in this course, while the reputation of the whole craft is made to suffer for the misdeeds of an unscrupulous minority. Honesty is decidedly the best policy in plumbing. The thorough workman is sure to reap the benefit of sound work. The time must always arrive when inferior work fails and when good workmen must be called on to replace it.

CHAPTER VI.

GAS FITTINGS AND OTHER FITTINGS.

Modern improvements include a vast number of conveniences, though at the same time, unless supervised with increasing watchfulness, and originally provided with the most intelligent care, their convenience is apt to be dearly purchased by the dangers they introduce.

Gas, unless in connection with thorough ventilation, is decidedly pernicious, but with good fittings and good ventilation, it is wonderfully convenient. The *Plumber* remarks:

"Great care is essential in choosing proper gas burners and replacing them when they are worn out. After years of use the best burners get worn out and become defective, causing both waste of gas and insufficient light. Vast improvements have been made in the construction of burners, but their value is often lessened by want of care in looking after them. The Scotch tip is generally admitted to be the best of the fish-tail lights; the American brass burner ranks next, while

I should rank the lava tap or bat-wing burner third. The philosophy of burners seems to be to secure as much surface with the least thickness of flame, in order to insure perfect combustion.

The size and shape of the lamp-shades employed has much influence upon combustion. We seem to be returning to first principles in making globes. The fish-tail globe of four inch orifice is the best pattern in vogue, and ensures steady combustion, without flickering.

American gas fixtures are unequaled by those made in any other country, strange to say, though the best designs to-day are made by foreign artists. Yet the work turned out by English manufacturers is behind the age. It is mostly stamped instead of being cast, while they make but little if any spelter work.

French gas fixtures display a certain attractive style, but lack finish, and are often merely fire gilt. Americans will go abroad and buy of foreign manufacturers goods in our line which are not a bit better than those made here, while they cost in many cases four times as much as those of American make. Our manufacturers spare no pains to make the best goods. A good designer is

paid as high as $5,000, while our facilities for working metals are unsurpassed. The gas fittings of one of our fine Fifth avenue houses sometimes cost upward of $5,000, and in some cases the patterns will be destroyed after the work is completed, so that it may be unique.

A marked change has taken place in the care with which gas pipes are fitted to houses. Formerly, when there were fewer gas companies, and each one controlled a certain district, there was a regular inspection of all piping laid, in respect to size, tightness of joints, etc. The standard size pipe for an ordinary dwelling was ½ inch, while all piping was required to sustain a test of 26 inches with a mercury gauge pressure pump.

Since the incorporation of so many new companies, which have no limit as to jurisdiction, a strong competition has sprung up as to which company shall supply consumers. Hence the gas fitter does not feel his former sense of responsibility to any one company, and is less subject to complaint and correction. Smaller pipes than are requisite are put in, while the jointing is done in so slovenly a manner that there are but few houses in any of our large cities that are free from leakage or which would stand the usual test."

Here is another opportunity for the self-respecting master plumber to put down his foot, and to insist on doing good work at fair prices.

Cisterns are very great conveniences when a constant water supply laid on by pipes is not available. The selection of the material of which they are made, and the care with which they are constructed and kept in order, demand intelligent attention. The following remarks by Mr. J. Bailey Denton, probably the foremost authority alive as to the science of sanitary engineering, seem to cover the ground very completely:

"There is no doubt whatever that water is often most injuriously affected by foul cisterns and foul pipes. Nevertheless, there are but few exceptions in which isolated dwellings, beyond the reach of a public supply, can exist without cisterns, while there are many in which the disgusting practice of placing them in or near attics which are used as sleeping apartments prevails. In fact, in many of the largest houses in the country this condition of things will be found to be the case.

"The best of all cisterns are those made of slate, enameled inside, and those that are constructed of wrought iron, properly

painted. Lead and zinc for the linings of cisterns are both decidedly objectionable, though I believe that lead is often condemned when the evil complained of is due rather to the effect of certain impure waters upon lead than to any general effect of lead upon pure water. It appears to me exceedingly doubtful whether pure water really has the effect —so often imputed to it—of quickly oxidizing lead.

"Where the whole of the water is raised to one service-cistern in the upper part of the dwelling, special arrangements should be made for the supply of water-closets and sculleries by separate subordinate cisterns, with ball-cock arrangements, so that the water required in either a water-closet or a scullery may be drawn without any *direct* communication with the main service-cistern. To remove defilements such as I have spoken of, a filter should be connected with all service-cisterns, through which the whole supply of the dwelling should pass as required for use."

Mr. George E. Waring, Jr., another accepted authority on sanitary engineering, has this to say about another matter:

"There is a somewhat active modern crusade against the stationary washbowl; and

as stationary washtub bowls are ordinarily arranged, the crusade is certainly justified. At the same time the convenience of these appliances and the degree to which they augment the luxury of an abundant water supply, and a good drainage system, are so great that it is worth an effort to retain them. A stationary wash-basin anywhere within the home is, under its existing conditions, in danger of becoming a channel for the influx of sewer gas; and even were our drainage pipes and sewers so carefully arranged as to reduce the production of foul gases to the minimum, it would still be most important to remove the possibility of the entrance of drain air anywhere within the house."

How this is to be done we have already shown, and so has Mr. R. Norman Shaw in the article we have quoted from him.

It remains for the plumber to be very fastidious and precise about all his work in connection with the washbowls, standing tubs, &c., &c.

The varieties of water-closets, basins, faucets, &c., with all sorts of patented devices "warranted to keep out sewer gas" are so numerous that we shall not attempt to enumerate them, or enter into any argument as to their respective merits. In point of fact,

if the soil pipe is ventilated, as it must be if sewer gas is to be kept out of a house, and siphoning prevented, one of these modern arrangements is practically pretty much as good as another. The only thing for the plumber is to be sure that they are set up in a thoroughly workmanlike manner.

What are the best materials for tubs, &c., is a matter open to considerable discussion, and after all is somewhat foreign to the business of the plumber. Whether a bath is made of marble, or tinned and planished copper, or soapstone, or slate, or sheet-iron, or, as in India, of *chunam* or stucco, really matters very little, as long as the water is supplied as freely as desired, and runs off freely, and the traps and pipes are in such thorough order that sewer gas is kept out of the house.

CHAPTER VII.

SOME THINGS WORTH KNOWING.

A GOOD JOINT.—Perhaps the best joint for iron or lead pipes, where steam is used, is what is called a "rust joint" of iron filings and sulphur. A six-story factory, which, with its steam expanding pipes and joints, had given a great deal of trouble, has apparently been put into proper shape, in a sanitary point of view, by the adoption of this "rust-joint," with, however, an additional arrangement which is kept profoundly secret by the inventor, who, however, says he can not get a patent on his device, and means to keep it to himself, as the only way to reap the benefit of it.

A GOOD CEMENT.—English Portland Cement and Rosendale Cement, used in combination, have been found very valuable.

A STRONG CEMENT.—A capital cement, very strong, and of which the materials are always readily procurable, is thus made: One heaped bushel of mortar made in the usual way for brick-work, add 3½ quarts

of iron scales, 1½ quarts of molasses; to be mixed in these proportions in quantity that can be used the same day.

A Very Powerful Cement.—A cement which unites itself closely with iron and stone or earthenware, which is insoluble in either hot or cold water, and causes no rust; is composed of resin and powdered brick-dust. The resin (either resin and gum mastic, or pitch and shellac), is melted, and sufficient brickdust added to give consistency.

WATER SUPPLY AND DRAINAGE.

Provide for each man, woman, and child, 15 gallons of water per day.

For each horse 16 gallons, four of which is consumed with his food.

For each four-wheeled carriage 16 gallons, and for each two-wheeled carriage nine gallons.

If the source is rainfall, provide tankage for 120 days' supply.

Service tanks should be capable of holding three days' supply.

To determine the size of pipes for water supply and drainage—

Let R=the hydraulic radius of mean depth

$$= \frac{\text{sectional area}}{\text{perimeter.}} = \text{in pipes} \frac{\text{diameter}}{4}$$

$$S = \text{the sine of inclination of pipe or} = \frac{\text{total fall}}{\text{total length}}$$

D=Diameter of pipe in feet.
V=Velocity in feet per second.
A=Sectional area in feet.
Q=Discharge in cubic feet per second.

Neville's formula—

$$V = 140\sqrt{RS} - 11\sqrt[3]{RS}$$
$$Q = AV$$
$$G = 293.729\, D^2 V = \text{Supply in gallons per minute.}$$

Eytelwein's formula—

Open Channels, etc.

$$V = 95\sqrt{RS}$$
$$Q = 95\, A\sqrt{RS}$$

Pipes.

$$V = 48\sqrt{DS}$$
$$Q = 37\sqrt{D^5 S}$$

Egg-Shaped Sewers.

$V = 50\sqrt{DS}$

$Q = 35\sqrt{D^5S}$ = Discharge when flowing $\frac{2}{3}$d full.

D being the diameter of the large circle.

The values of Q obtained from Eytelwein's formula are less than those obtained from Neville's. The latter is the most accurate for straight pipes free from obstructions, but an allowance of from $\frac{1}{3}$ to $\frac{1}{4}$ is required for curves and sudden changes of direction.

Allow for incrustation, etc., $\frac{1}{6}$ of the diameter of pipes under 3 inches, $\frac{3}{4}$ of an inch for pipes between 3 and 6 inches, and 1 inch for all diameters above 6 inches.

The loss of head in inches due to bends may be taken approximately as equal to the product of the square of the velocity in inches per second, and the sum of the squares of the sines of the angles of the bends multiplied by the constant number .0003.

In short pipes when the length does not exceed 1000 diameters, a correction will have to be made for the loss of head due to veloc-

ity and to the form of the orifice at the junction of the pipe with the reservoir.

Let h = the loss of head in feet.

v = the velocity in feet per second, and which may be obtained from the tables as a first approximation.

Then

$$h = Cv.$$

C = .0234 for round orifices, such as the end of a pipe when flush with the side of the cistern.

= .0155 ditto when bell-mouthed.

= .0303 ditto when the pipe projects into the cistern.

The value of h thus obtained must be deducted from the total head before entering the table for a new velocity, which, unless the pipe is very short, will be sufficiently near for practice. Any further degree of accuracy may be attained by repeating the operation, and using the last obtained velocity in each case.

In practice it is considered that 5 feet of head per mile is required to maintain a flow and to overcome friction in small pipes.

In SEWERS provide for removing of rainfall per hour—

From roofs	.5	inch in depth.
Flagged surfaces	.2	" "
Graveled "	.05	" "
Meadows or grass plots	.02	" "
Paved surfaces	.10	" "

Sewerage 5 cubic feet per head of men, women and children to be removed in 24 hours, one-half of which passes off in from 4 to 6 hours.

Two feet per second is the least velocity which will keep sewers clear of all ordinary obstructions. House drains and small pipes require a velocity of three feet per second to keep them clear.

THE PRESSURE OF WATER AGAINST WALLS, SIDES OF CISTERNS, ETC.

A=Area of surface pressed in feet.

H=Depth of center of gravity below surface in feet.

Then

$$\text{Pressure in lbs.} = 62\tfrac{1}{2}\ A\ H.$$

The pressure may be considered as acting at a point $\frac{2}{3}$ds of the total depth from the top.

THE DISCHARGE OF WATER THROUGH ORIFICES, SLUICES, ETC.

A=Area of orifice, etc., in feet.
H=Depth of water from surface to center of orifice in feet.
Q=Quantity discharged in cubic feet per second.
V=Velocity in feet per second.

$$V=C\sqrt{H}.$$

$$Q=AV.$$

C=4.98 for all orifices in thin plates.
=6.00 " short tubes.
=5.00 " sluices without side walls, etc.
=7.00 " ditto with side walls, and for wide openings whose bottom is level with that of the reservoir.
=6.50 " narrow openings.

GAS SUPPLY.

Let D=Diameter of pipe in inches.
G=Specific gravity of gas.
L=Length of pipe in yards.

P=Pressure in inches by the water gauge.

Q=Quantity of gas supplied in cubic feet per hour.

$$D=C\sqrt[5]{\left\{\frac{G\,L\,Q^2}{P}\right\}}$$

$$Q=M\sqrt{\left\{\frac{D^5\,P}{G\,L}\right\}}$$

Value of C for service pipes= .073.
" main pipes = .063.
Value of M for service pipes= 780.
" main pipes =1000.

To find the diminished pressure=p at the end of the main pipe when there are no branches supplied from it.

$$p=P-.55\frac{G\,L\,Q^2}{D^5}$$

The value of G ranges from .4 to .5; atmospheric air being 1. In general it may be assumed at .45.

P is reduced by friction and leakage from about 25 *tenths* of an inch at the works to about 3 *tenths* at the burner, according to distance. It also varies at the rate of about $\frac{1}{100}$ of an inch for every foot of rise or fall in the inclination of the pipe.

To regulate the pressure in the higher levels, governors are usually placed at every

30 feet of elevation, and siphons at every depression to receive the water which drains from the pipe.

Allow four cubic feet of gas per hour for internal lights and 5 cubic feet for external lights. When large or Argand burners are used allow from 6 to 10 cubic feet per hour.

VENTILATION, ETC.

The draught of velocity of air in feet per second from chimneys or ventilating shafts.

H=Height of shaft or of heated column of air in feet.

T=Temperature of room in deg. Fahr.

t=Temperature of external air.

$$\text{Velocity} = .365\sqrt{H(T-t)}$$

The retardation of the air by friction in passing through straight tubes will be directly as the length and square of the velocity and inversely as the diameter.

A full grown man requires at least 3 cubic feet of atmospheric air per minute.

Sleeping apartments require 1000 cubic feet of space for each occupant.

An ordinary window with the usual accuracy of fitting allows from 5 to 8 cubic feet of air to pass through per minute, according to the difference of temperature between the internal and external air.

Concrete is usually formed of 1 part lime, 2 parts sand, and 5 parts of broken stone or shingle.

Where ballast or gravel containing sand is used, the proportions are 1 part of lime and 7 parts of ballast, etc.

The lime and ballast, etc., lose about $\frac{1}{5}$ of their bulk when made into concrete.

An expansion takes place in concrete during the slaking the lime, to the extent of about three-eighths of an inch to every foot in height, which it retains permanently.

WEIGHT OF WATER.

According to Act of Parliament 5 Geo. IV., c. 74, a cubic inch of pure water at 62° F. weighs 252.458, from which we calculate that its weight at 60° F. should be 252.5, or 4 cubic inches=1010 grains; the weight, therefore, of a cubic foot is 62.33 lbs. The weight of a cubic foot is generally assumed by engineers as $62\frac{1}{2}$ lbs., or 1,000 ounces. The following table of approximate values will be useful in all practical calculations founded on English measures of weight and capacity:

1 cubic foot of water		=1000 oz.
1 cubic foot	"	=$62\frac{1}{2}$ lbs.
16 cubic feet	"	=1000 lbs.

36 cubic feet	"	$=1$ ton.
1 cubic yard	"	$=\frac{3}{4}$ tons.
1 cubic fathom	"	$=6$ tons.

When the weight is required in tons, reduce the linear dimensions to fathoms, and multiply the volume by 6.

For calculating water pressure in pounds per square inch, we must find the weight of a prism of water one foot high, standing on a square inch.

$$\text{Weight}=\frac{1010\times12}{4\times7000}=\frac{3.03}{7}$$

Therefore we have the following rule:

For every 7 *feet of depth allow* 3 *lbs. pressure per square inch. To the result add one per cent.*

For calculating water pressure on circular areas, we must find the weight of a cylinder of water one foot high and one inch in diameter.

$$\text{Weight}=\frac{11}{14}\times\frac{1010}{4}=\times\frac{12}{7000}=\frac{34}{100}$$

Therefore we have the rule:

For every 100 *feet of depth allow* 34 *lbs. pressure per square inch of diameter squared.*

For sea water, which has a greater density, add to the results of all such calculations $2\frac{1}{2}$ per cent., or one-fortieth part.